



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/604,081	06/25/2003	Kangguo Cheng	FIS920030155US1	1080

32074 7590 10/05/2004

INTERNATIONAL BUSINESS MACHINES CORPORATION
DEPT. 18G
BLDG. 300-482
2070 ROUTE 52
HOPEWELL JUNCTION, NY 12533

EXAMINER

KENNEDY, JENNIFER M

ART UNIT

PAPER NUMBER

2812

DATE MAILED: 10/05/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/604,081

Applicant(s)

CHENG ET AL.

Examiner

Jennifer M. Kennedy

Art Unit

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 July 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17, 21, 22 and 27-29 is/are pending in the application.
- 4a) Of the above claim(s) 17, 21 and 22 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 11-12 is/are allowed.
- 6) ☒ Claim(s) 1-10, 13-16 and 27-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

In view of Applicants' amendment to claim 15, the objection has been withdrawn.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 8-10, 14, 27 and 29 are rejected under 35 U.S.C. 102(b) as being anticipated by Schrems et al. (U.S. Patent No. 6,200,873).

In re claim 1, Schrems et al. discloses the method for forming a buried plate in a trench capacitor the method comprising the steps of (see specifically Column 11, line 60 through column 13, line 8 and Figures 10a-10e):

forming at least one trench (108) with a sidewall in a semiconductor substrate;
partially filling the trench with a dopant source material (177) to form a dopant source having a top surface below the top of the trench (see Figure 10b), the dopant source material containing at least one dopant;

covering the sidewall of the trench above the dopant source with a second material (167);

heating the substrate to cause the dopant to diffuse into the substrate in the trench not covered by the second material, thereby forming the buried plate (see column 12, line 40-53); and

removing the dopant source material from the trench (see column 12, lines 55-28, see Figure 10e).

In re claim 2, Schrems et al. discloses the method wherein the semiconductor substrate is formed of silicon (101, see column 11, lines 60-61, and column 2, lines 50-55).

In re claim 3, Schrems et al. discloses the method wherein the trench is partially filled by a method comprising the steps of filling the trench with a dopant source material (177) to form a dopant source having a top surface at or above the top of the trench (see Figure 10a); and recessing the top surface of the dopant source below the top of the trench (see Figure 10b, column 12, line 25-35).

In re claim 4, Schrems et al. discloses the method wherein the dopant source material is arsenic doped glass (see column 11, line 62 through column 12, line 5).

In re claim 8, Schrems et al. discloses the method wherein the substrate is heated to a temperature of about 800 C to about 1200C for a time of about 1 to about 60 minutes (see column 12, line 40-53).

In re claim 9, Schrems et al. discloses the method wherein the substrate is heated to a temperature of about 1050 C (see column 12, line 40-53).

Art Unit: 2812

In re claim 10, Schrems et al. discloses the method wherein the substrate is heated in an oxygen containing atmosphere (see column 12, line 40-53). The examiner notes that oxygen molecules must be present in order to effect thermal oxidation.

In re claim 14, Schrems et al. discloses the method wherein the second material (167) is removed (see column 12, lines 53-54 and Figures 10c and 10d).

In re claim 27, Schrems et al. discloses the method further comprising the step of exposing the substrate to at least one of gas phase doping, plasma doping and plasma immersion ion implantation (see column 12, line 4-6). The examiner notes that PLAD is a plasma ion doping step.

In re claim 29, Schrems et al. discloses the method wherein the sidewall of the trench is covered by forming a dielectric collar on the sidewall above the dopant source (see column 12, lines 35-42).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schrems et al. (U.S. Patent No. 6,200,873) in view of Mei (U.S. Patent No. 6,232,171).

In re claims 5-7, Schrems et al. discloses the method as claimed and rejected above, but does not disclose the method wherein the dielectric collar is formed of nitride or by a low pressure chemical vapor deposition (LPCVD) or the method further comprising the step of forming a thin layer of oxide on the sidewall of the trench prior to forming the dielectric collar.

Mei discloses the method wherein the dielectric collar is formed of nitride (180') by a low pressure chemical vapor deposition (LPCVD, see column 7, lines 60-65) and further comprising the step of forming a thin layer of oxide (120') on the sidewall of the trench prior to forming the dielectric collar.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the collar of Schrems of a nitride by LPCVD, and to form an oxide layer on the sidewall of the trench prior to forming the nitride dielectric collar since the nitride allows for prevention of oxidation on the upper portion of the trench when forming the increased surface area bottle shape trench (see column 8, lines 25-33). Further, the nitride allows for etching selectivity when removing the sacrificial layer formed in the bottom of the trench (see column 8, lines 1-6). Finally, the oxide improves the adhesion between the nitride layer with the silicon sidewall.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schrems et al. (U.S. Patent No. 6,200,873) in view of Tsai et al. (U.S. Patent No. 6,706,587).

In re claim 13, Schrems discloses the method as claimed and rejected above but does not disclose the method of depositing a plurality of hemispherical grains in the

Art Unit: 2812

trench after the dopant source material is removed. Tsai et al. disclose the method of depositing a plurality of hemispherical grains in the trench after the dopant source material is removed (see column 1, lines 45-52). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form hemispherical grains in the trench of Schrems et al. after the dopant source is removed, as Tsai et al. teaches, in order to form a trench with more surface area so as to increase the capacitance of the device (see Schrems et al. column 9, lines 54-60).

Claims 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schrems et al. (U.S. Patent No. 6,200,873) in view of Kudelka et al. (U.S. Patent Appl. 2001/0016398).

In re claims 15 and 16, Schrems et al. disclose the invention as claimed and rejected above, but does not disclose the method of etching the substrate in the lower portion to form a bottle shape trench after the dopant source material is removed or the method wherein the substrate is etched using ammonia. Kudelka et al. disclose the method of etching the substrate in the lower portion to form a bottle shape trench after the dopant source material is removed and wherein the substrate is etched using ammonia (see paragraphs [0040-0043]).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a bottle shape trench after the dopant source material is removed in order to form a trench with increased surface area which in turn allows for higher capacitance (see Kudelka et al. paragraph [0004]).

Art Unit: 2812

The examiner notes that while Kudelka et al. does not expressly disclose ammonia, they do disclose ammonium hydroxide. Ammonium hydroxide is simply ammonia in a water solution, which is necessarily what ammonia would become in a wet etching process such as Kudelka et al.'s. The examiner has provided a copy of page 150 of Chemistry and Chemical Reactivity, which is an elementary chemistry book, which shows that ammonia when added to water dissociates and forms an aqueous solution of ammonium hydroxide. Thus, Kudelka et al. discloses the use of ammonia and water to etch the substrate. Further, the examiner notes that Kudelka et al. discloses any base may be utilized. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize ammonia for a wet etchant as taught by Kudelka et al. since ammonia is an inexpensive and readily available base.

Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schrems et al. (U.S. Patent No. 6,200,873) and Tsai et al. (U.S. Patent No. 6,706,587) in view of in view of Bronner et al. (U.S. Patent No. 6,177,696)

In re claim 28, the combination of Schrems et al. and Tsai et al. disclose the method as claimed and rejected above, but does not disclose the method of exposing the substrate to at least one of gas phase doping, plasma doping and plasma immersion ion implantation, after depositing a plurality of hemispherical grains. Bronner et al. discloses the method of exposing the substrate to at least one of gas phase doping, plasma doping and plasma immersion ion implantation, after depositing a

Art Unit: 2812

plurality of hemispherical grains (see column 6, lines 15-27). It would have been obvious to one of ordinary skill in the art at the time the invention was made to dope the substrate after depositing the plurality of hemispherical grains in order to have a lower electrode with greater conductivity and thus increased capacitance.

Allowable Subject Matter

Claims 11 and 12 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: the prior art, either singly or in combination, fails to anticipate or render obvious, the method including the limitations of heating a substrate in an oxygen containing environment wherein during the heating step, a layer of oxide is grown between the dopant source material and the substrate in combination with the other limitations of claims 11 and 12. The examiner notes that while Schrems et al. (U.S. Patent No. 6,200,873) discloses the heat treatment can be carried out in an oxygen atmosphere, it does not disclose the method of forming an oxide between the dopant source material and the substrate. There is no expectation of an oxide to form between the dopant source material and the substrate since the oxygen of the atmosphere would be required to diffuse through oxide layer 167, sacrificial polysilicon layer 152, and then through ASG layer 177.

Response to Arguments

Applicants' arguments filed July 21, 2004 have been fully considered but they are not persuasive.

Applicants argue that examiner should not have withdrawn the non-elected claims from consideration yet. The examiner notes that it is customary to withdraw claims from consideration when they are directed to a non-elected embodiment. The examiner assures applicants that these claims are only withdrawn from consideration, not cancelled, and therefore, are subject to rejoinder if a generic claim is found to be allowable.

Applicants argue that neither Schrems et al. nor any of the other cited prior art disclose that the trench is partially filled with a dopant source material to form a dopant source having a top surface below a tip of the trench, the dopant source material containing at least one dopant. The examiner refers Applicants to the rejection set forth wherein it is noted that Schrems et al. teaches partially filling the trench with a dopant source material (177) to form a dopant source having a top surface below the top of the trench (see Figure 10b), the dopant source material containing at least one dopant.

Applicants argue that Schrems et al. teaches forming a layer, not partially filling the trench. Merriam-Webster's defines fill as **1 a** : to put into as much as can be held or conveniently contained. The examiner notes that the layer formed by Schrems et al. is a portion of what can be held in the trench, and thus partially fills the trench as seen in Figure 10b.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hoepfner (U.S. Patent No. 6,008,103) discloses that PLAD

Art Unit: 2812

stands for plasma doping in the art. Kotz et al. (Chemistry and Chemical Reactivity, Second Edition. page 150) is cited for teaching ammonium hydroxide is formed by the dissociation of ammonia in water.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

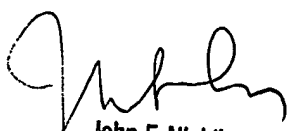
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Kennedy whose telephone number is (571) 272-1672. The examiner can normally be reached on Mon.-Fri. 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (571) 272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2812

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


jmk


John F. Niebling
Supervisory Patent Examiner
Technology Center 2812